Lummi Nation Wellhead Protection Program
Ordinance Development Literature Review

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1. INTRODUCTION

This literature review was undertaken as part of the Lummi Nation Wellhead Protection Ordinance development effort. The purpose of this review is to examine ground water management plans and wellhead protection ordinances developed by other governments, and to summarize how various governments throughout the United States protect their ground water resources.

The Water Resources Division of the Lummi Natural Resources Department is charged with developing and implementing a Comprehensive Water Resources Management Program (CWRMP). The CWRMP includes action plans for wellhead protection, storm water management, and wetlands management. An integral part of the program development effort includes literature reviews of existing plans and ordinances for each action plan. The literature reviews are used for guidance in developing an approach that uses active management to protect the valuable water resources on the Lummi Indian Reservation (Reservation).

This report is divided into five sections including this introduction. Section two summarizes the variety of approaches used to protect ground water resources. Section three reviews plans, guidelines, and ordinances developed by tribes, states, and local governments to protect ground water. Section four summarizes and concludes the report. A listing of the literature reviewed is presented in section five.

2. GROUND WATER PROTECTION

The federal Safe Drinking Water Act (SDWA) was enacted in 1974 to ensure that public drinking water suppliers in the United States provide safe and healthy drinking water to their communities. A 1986 amendment to the SDWA mandates each state to develop a wellhead protection program. The U. S. Environmental Protection Agency (EPA) is charged with implementing the SDWA and provides tribes, states, and local governments with rules, regulations, and guidance documents intended to guide the development of local drinking water protection plans including wellhead protection (EPA 1992, EPA 1998a). The federal government also has a number of other Acts (e.g., Resource Conservation and Recovery Act [RCRA]; Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]; Federal Insecticide, Fungicide, and Rodenticide Act [FIFRA]; Toxic Substance Control Act [TSCA]; and Clean Water Act [CWA]) that provide technical background information, rules, and regulations to assist communities with resource protection. Protecting ground water drinking supplies requires protecting the source aquifer.

Aquifers are geologic formations, groups of formations, or part of a formation capable of storing and yielding ground water to wells and springs (Driscoll 1986). Aquifers are vulnerable to contamination from a variety sources including: spills of hazardous substances, land uses and activities, saltwater intrusion due to over pumping, and microbial or viral organisms from faulty on-site septic systems or leaking sewer lines

(EPA 1987). Contaminated surface water can enter the aquifer by infiltration into permeable soils and through improperly constructed wellheads.

A variety of approaches are used by governments to protect ground water including: zoning ordinances, health ordinances, critical areas ordinances, and wellhead protection ordinances. Protecting the areas around wellheads and/or aquifer recharge areas from potential contamination is the predominant approach used in ordinances intended to protect critical ground water supplies. It is much cheaper to protect an aquifer than to try to clean it up. Some damage to aquifers may not be repairable.

As defined by the SDWA, a Wellhead Protection Area (WHPA) is the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield (SDWA 1986). Section 1401 of the SDWA defines contaminants to be any physical, chemical, biological, or radiological substance or matter in water. To ensure ground water protection, many governments manage abandoned wells to reduce the risk of contamination by designating a WHPA for all wells. The WHPAs are typically broken into zones with the more stringent regulations applying to the zones immediately surrounding the well and less stringent regulations for the outer zones.

Wellhead Protection Areas are commonly subdivided into zones based on either a linear distance from a well, or with a radius based on the time of travel (TOT) for ground water movement to the well. The TOT is the amount of time required for ground water or a contaminant to flow from a point within the contributing area to the well. The literature reviewed designates three protection zones. Zone 1 can range from 100 feet to 400 feet for the fixed radius method and up to a buffer of 1,000 feet buffer around a one-year time of travel zone. Zone 1 has the most stringent restrictions on land uses and activities. Zones 2 and 3 are usually based on time of travel estimates with defined prohibited and conditional uses. Some Wellhead Protection Plans include buffers adjacent to and upslope of Zone 3 (Swinomish Indian Tribal Community 1998, Washington 1995). Examples of Zone 1 sizes are:

- A radius of 100 feet for all wells except those in carbonate geologic formations which require a radius of 400 feet (Lancaster County 1998);
- A radius of 400 feet for all wells (Massachusetts 1991);
- A radius of 500 feet for wells pumping less than 100,000 gallons per day (GPD) and the area between the well and the two year TOT for wells pumping greater than or equal to 100,000 GPD (Hernando County 1998);
- The perimeter of the one year TOT (Washington 1995); and
- a linear distance of 1,000 feet from the one year TOT perimeter (Swinomish Indian Tribal community 1998).

Zone 2 is often based on TOT. Both the Swinomish Indian Tribal Community (1998) and the State of Washington (1995) define Zone 2 as the area between the one-year and five-year TOT. Hernando County defines Zone 2 as the area between the two-year and ten-year TOT (1998). Massachusetts defines Zone 2 (in some instances they call it the

interim WHPA) as the area of an aquifer that contributes water to a well under the most severe pumping and recharge conditions (Massachusetts 1998). For wells pumping greater than 100,000 GPD, this area is approximately one-half mile radius around each well. For wells pumping less than 100,000 GPD, the distance is proportionate to the approved daily volume.

Three government documents reviewed designate a Zone 3. Again, both the Swinomish (1998) and Washington State (1995) define Zone 3 as the area between the five-year and ten-year TOT. Lancaster County defines Zone 3 as the land area upon which rainfall eventually makes its way into the wellhead or spring (Lancaster County 1998).

Some ground water protection plans use other approaches to protect the area around ground water supplies. The City of Stratham, New Hampshire (1998) defines their Aquifer Protection Districts as the aquifer recharge areas delineated by the ground water mapping studies entitled Lampre/Exeter/Oyster River Study and Lower Merrimack Coastal Study. These areas are mapped on a geographic information system (GIS) overlay that can be used by city planners to determine the proximity of proposed or existing uses within aquifer recharge areas.

The Tulalip Tribes (1995) are developing a Wellhead Protection Plan (WHPP) for specific wellheads. They have written language into their Watershed Management Plan to protect all existing forested areas and to identify and protect all basins with soils having a high infiltration capacity. They also have plans to protect, with buffers, all critical and high value wetlands.

Nearly all ground water protection plans depend on public involvement and education for achieving program objectives. Public involvement includes citizen participation throughout the process, posting information concerning the planning effort, holding public hearings on the plans, and adjusting the plans according to community values and concerns.

Public education takes many forms. Many agencies, including the EPA, Washington State Department of Ecology, and Kitsap County Health Department, have developed information packets targeting different audiences (e.g., small well owners and public drinking water supply providers). Information packets are also available on a variety of related topics (e.g., septic system management; household hazardous waste disposal; and new, abandoned, and replacement wells). The EPA has a number of resources available (a web site, publications, public meetings) to assist local governments in educating their community members (EPA 1999b, EPA 1998c, EPA 1998d). The National Drinking Water Clearinghouse has a web site (www.esto.wvu.edu/ndwc/ NDWC_homepage. html) that explains some of the problems associated with owning a home in WHPAs and the types of behavior changes necessary to reduce the risk of contaminating local ground water. Kitsap County has developed guidance for small private wells to reduce the risk associated with chemicals and other contamination sources found throughout the home (1998b). Washington State provides local governments and citizens information to help protect ground water resources (Washington 1997).

The City of Olympia, Washington has a full time staff person responsible for developing and implementing all public involvement and education (PIE) programs concerning water resources. Olympia has developed the four following objectives to assist with the planning, implementation, and evaluation of the effectiveness of their PIE program (Olympia 1997):

- Develop and implement a marketing strategy and design PIE activities and products that will increase awareness of everyone living and working in well source protection areas of their role in well source protection.

- Provide education and technical assistance to business owner/managers, farmers, and institutional and school facility managers in well source protection areas, beginning with all facilities in the Allison Springs area in 1998-1999.

- Provide one-on-one education and technical assistance to up to 250 homeowners and residents of well source protection areas each year through the Home Assessment Program.

- Develop educational programs for elementary and secondary school classrooms in 1998-1999.

Each of these objectives were developed with a full outline on the specific steps necessary to achieve the objective.

3. PLANS, GUIDELINES, AND ORDINANCES

One of the primary concerns of public agencies is the protection of public water supplies (including small private wells) from contamination by toxic, hazardous, or injurious substances. The typical approach includes identifying potential contamination sources, listing all regulated substances located at these sources, and developing guidelines for the safe handling, use, storage, and transport of these materials.

Some governments have developed criteria for prohibiting and/or allowing with provisions land uses and activities that have the potential to threaten drinking water supplies. An area of particular concern for many local and state governments is the regulation within WHPAs of above/underground storage tanks and pipelines moving sewage, commercial waste, industrial waste, or petroleum products (City of Dayton 1998, Massachusetts 1991, City of Stratham 1998).

All of the wellhead/ground water protection plans/guidelines reviewed shared the following common themes:

- The active management of land uses and activities;
- The inventory and management of regulated substances.

These planning document themes are incorporated into ordinance language along with definitions, enforcement, and severability clauses. All of the ordinances reviewed contained a set of definitions for all terms used to legally protect ground water drinking supplies. All of the reviewed ordinances also have a severability clause. This clause protects the overall validity of the ordinance in the event that sections, sentences, or phrases are found to be unconstitutional.

Most of the ordinances adopted have some form of enforcement language. There is variability of the penalties associated with non-compliance ranging from a misdemeanor fine to jail time. The cities of Olympia (1998) and Stratham (1998) have penalties of $100 per day of violation with Olympia having up to $5,000 and/or up to 90 days in jail for repeat or intentional violations. The City of Dayton (1998) classifies violations as minor misdemeanors. The Swinomish Indian Tribal Community (1998) and Hernando County (1998) have fines of up to $500 and/or up to 60 days in jail.

3.1 TRIBAL APPROACHES

Different approaches have been taken by tribal governments located in Washington State. The approaches taken by the Makah Nation, the Swinomish Tribe, and the Tulalip Tribes are presented below.

The Makah Environmental Division is developing complementary environmental regulations that protect ground water. These regulations include designating areas of special concern, such as water supplies (Makah Indian Nation 1996), assisting Tribal organizations and staff to understand National Pollutant Discharge Elimination System (NPDES) permitting (Makah Indian Nation 1998a), and implementing a Solid Waste Disposal Ordinance within reservation boundaries (Makah Indian Nation 1998b). Makah environmental regulations require the Makah Land Use and Environmental Commission (Commission) to prepare a Tribal Land Use and Development Plan. This plan designates two types of construction: 1) low impact construction (no perceived negative environmental impacts) and; 2) general development which requires an Environmental Assessment (EA) and/or an Environmental Impact Statement (EIS). The Commission has the authority to conduct hearings, enforce orders, and issue/condition/deny appealed permits. Ground water drinking supplies will be protected through this coordination of regulations.

The Office of Planning and Community Development of the Swinomish Indian Tribal Community has developed a Wellhead Protection Ordinance to protect the sole source drinking water supplies for their community. This ordinance regulates land uses and activities within designated WHPAs to reduce the risk of contamination from viral, microbial, and chemical contamination (Swinomish Indian Tribal Community 1998). The Wellhead Protection Ordinance requires a 500-foot buffer upgradient and adjacent to

Zone 3. This ordinance also defines how enforcement, complaints, and inspections shall be implemented.

The Swinomish Tribal Community has developed stringent criteria for land uses within all WHPAs. For example, the following activities are prohibited in all WHPAs (Swinomish Indian Tribal Community 1998):

1. Animal burial or disposal sites;
2. Application of pesticides, herbicides, or fertilizers;
3. Auto service, repair, or painting facilities;
4. Car washes;
5. Chemical manufacturing;
6. Collection, storage, or disposal of hazardous wastes;
7. Collection, storage, or disposal of petroleum products;
8. Disposal of solid wastes;
9. Dry cleaning or laundry facilities;
10. Feedlots;
11. Incinerators;
12. Junk or salvage yards;
13. Landfills;
14. Meat or vegetable processing facilities;
15. Open burning or detonation sites;
16. Processing or storage of oils containing PCB; and
17. Wood treatment facilities.

While these land use activities are expressly prohibited in all WHPAs within the Swinomish Reservation boundaries, a number of land use activities with the potential to contaminate ground water are allowed within Zones 2 and 3 provided they meet certain performance standards and other zoning codes and regulations. The following land uses are conditionally allowed in Zones 2 and 3 (Swinomish Indian Tribal Community 1998):

1. Agriculture;
2. Horticulture;
3. Park, greenways, or publicly owned recreation areas;
4. Timber harvest;
5. On-site septic disposal; and
6. Necessary public utilities or facilities designed so as to prevent contamination of ground water.

The Wellhead Protection Ordinance is part of the Swinomish Comprehensive Land Use and Natural Resource Policies and is applied in accordance with the Swinomish Zoning Ordinance, Comprehensive Plan, Comprehensive Water Facilities Plan, Water Resource Protection Ordinance, and Coastal Zone Management Plan.

The Tulalip Tribes have developed a Watershed Management Plan (1995) which uses a basin-by-basin approach to resource protection. The management plan identifies all

important aquatic resources, potential threats to these aquatic resources, and approaches designed to protect these resources from degradation within each watershed located on the reservation. The Tulalip (1994) have adopted a Zoning Ordinance that uses buffers to protect wetlands, streams, and environmentally sensitive lands (including wellhead protection areas) from risky land uses and activities. The Tulalip are also developing a Sanitation Ordinance in an attempt to reduce septic tank failure problems. In general, the Tulalip are using Best Management Practices (BMPs) to protect all aquatic systems in an attempt to reduce the risks of degrading surface and ground water quality.

3.2 STATE GUIDANCE

Throughout the country, states have taken different approaches to encourage county and city municipalities to protect ground water drinking supplies. This review summarizes guidance documents created by the states of New Hampshire, Massachusetts, Oregon, and Washington. The guidance documents provide direction for local governments. Local governments can follow these guidelines specifically or they can develop alternative methods of protecting ground water resources for their citizens.

The State of New Hampshire (1998) developed a health ordinance model intended to protect ground water. The model ordinance attempts to protect ground water by defining the areas to be protected, identifying existing threats, and actively managing land uses and activities through education and inspection. New Hampshire's model presents three approaches to wellhead protection:

1. Reclassify ground water as either:
    - ground water within delineated WHPAs;
    - ground water of high value for present or future use;
2. Adopt a local health ordinance in conjunction with reclassifying ground water; and
3. Adopt a local health ordinance without reclassifying ground water.

The first two approaches were developed for larger municipalities that have the resources and staff to handle the work involved with delineating WHPAs and identifying existing potential threats to ground water quality. The third approach was developed for small governments in an attempt to protect vital drinking water supplies without spending a lot of time and money studying the area.

The key to using a health ordinance for regulating land use activities involves a system of identifying potential threats, working with the sources of these threats through a permit and inspection system, and enforcing compliance with administrative codes. All facilities that handle regulated substances within a WHPA must be permitted, use BMPs (including BMPs not included in state administrative rules), and allow inspection of facilities at least once every three years. New Hampshire's active management approach attempts to clearly define procedures and responsibilities for local implementation and authorizes the local health officer to enter and inspect private property in order to ensure a management program is implemented for risky land use activities.

The State of Massachusetts (1991) takes a slightly different approach to protecting public drinking water. The two categories for water supply protection areas are surface water and ground water. For surface water protection areas, activities involving the burying of bodies and human or livestock waste generation, storage, or disposal facilities are prohibited within 100 feet of reservoirs and their tributaries. Other activities, like the release of commercial or industrial residue containing poisonous or injurious substances, the manufacture or processing of toxic or hazardous waste, or the placement of underground storage tanks, are prohibited within reservoir watersheds. For ground water, all new public supply wells must own or control the protection Zone 1 (400 foot radius) of the well (Massachusetts 1991). Zone 2 is not specified by size but includes areas adjacent to Zone 1. A variety of land uses and activities, including impervious surfaces greater than 15% of the total area, are prohibited in Zone 2.

Oregon protects ground water supplies with rules administered by both the Department of Environmental Quality (DEQ) and the Oregon Health Department (OHD). The rules provide a framework for developing local plans in a consistent manner and describe how these plans can be certified (Oregon 1998). This approach authorizes OHD to provide for the delineation, contingency, and new wells elements of wellhead protection while DEQ administers the wellhead protection program, certifies all plans, and provides for all elements not regulated by OHD.

To ensure success in protecting ground water drinking supplies, Oregon integrates their wellhead protection program with other state agencies including the Health Division, Department of Agriculture, Water Resources Department, and the Department of Land Conservation and Development. Each of these areas of state government are involved by developing internal rules, providing information and technical assistance, and encouraging local participation and compliance.

Oregon guidelines define a set of required elements necessary to meet certification. These guidelines include: 1) the specification of duties for the various agencies, 2) the delineation of WHPAs, 3) inventory of potential contamination sources, 4) management of potential contamination sources, 5) contingency plans, 6) the siting of new wells, and 7) public participation. All certified WHPPs must be recertified every five years. Plans can also be appealed during the developmental stages and inactive plans can be decertified.

The State of Washington uses a variety of approaches to protect ground water. As one of the elements of the Growth Management Act, the Critical Areas Ordinance (CAO) for each county or city requires protection of critical aquifer recharge areas from contamination. Washington's State Environmental Policy Act (SEPA) also provides guidance for dealing with proposed land uses within critical aquifer recharge areas. A 1994 Washington State law modified state Drinking Water Regulations by mandating that all new and existing Group A wells (serving 15 or more connections or 25 or more

people) develop WHPPs. Washington State Department of Health is charged with working in coordination with local governments, the Department of Ecology, and the Department of Agriculture in developing and implementing WHPPs (Washington 1995).

3.3 COUNTY AND CITY

Within different states, counties and cities have taken a variety of approaches to protect ground water resources. This section discusses approaches taken by the cities of Dayton, Ohio; Stratham, New Hampshire; and Olympia, Washington; and the counties of Lancaster, Pennsylvania; Hernando, Florida; and Pierce, Kitsap, and Thurston, Washington.

The City of Dayton, Ohio has developed a draft wellhead protection ordinance which uses a GIS overlay to assist city planners when reviewing land use applications. If the proposed application is within a WHPA, the ordinance provides guidelines for the planners to issue, condition, and/or deny permits (City of Dayton 1998). To enforce this ordinance, a public water supply protection authority is established to oversee inspections, appeals, and any other enforcement situations that might occur (e.g., vandalism, leaks, spills).

The City of Stratham, New Hampshire identifies Aquifer Protection Districts (APD) and regulates land use activities within each district. A major part of this plan includes surface water runoff management (including limiting the percent of an area covered by impervious surfaces). For any allowable land use within an APD, BMPs must be followed to reduce potential risks to the aquifer (City of Stratham 1998).

The City of Olympia, Washington has adopted a WHPP that closely follows state guidelines (1998). Olympia has chosen to focus the active management of its WHPP through their public involvement and education program described previously. The public involvement and education program integrates all water resource projects in the City (City of Olympia 1997). The Olympia Water Resources Division approaches businesses through "Operation: Water Works" (a program that provides technical assistance) and local citizens through "Stream Team" (a program that involves and educates local residents).

Lancaster County, Pennsylvania is concerned with geologic formations that allow for the rapid infiltration of precipitation and the contaminants that can leach into subsurface water (Lancaster County 1998). Lancaster County works with developers in the planning stages in an attempt to influence site planning. The County's intent is to focus development on those portions of property that have no significant impact on critical areas while preserving the integrity of the critical areas.

Hernando County, Florida has designated the entire county a "ground water resource protection area" in its Groundwater Protection and Siting Ordinance (Hernando County 1998). This ordinance defines WHPAs based on the capacity of water supplied from the

well to the community. This ordinance also regulates land uses and activities around Special Protection Areas (SPAs), areas with vulnerable features which have the potential to discharge directly to the aquifer.

Pierce County, Washington protects ground water resources with their Critical Areas Ordinance (CAO). Within this ordinance is language to protect aquifer recharge areas by establishing minimum standards for development of sites which contain or are adjacent to critical areas (Pierce County 1997). These minimum standards are intended to promote the public health, safety, and welfare by mitigating unavoidable impacts and protecting from negative impacts. The CAO is coordinated with the county zoning code to regulate land uses and activities.

Kitsap County, Washington also protects aquifer recharge areas with its CAO. In addition, Kitsap County developed a WHPP to protect the quality of drinking water derived from ground water and to safeguard ground water sources against contamination (Kitsap County 1998a). Kitsap County has also developed a Surface Water Management Plan to further reduce the risk associated with contaminated surface water (Kitsap 1994). The focus of the Storm Water Management Plan is pollution prevention.

Thurston County, Washington has developed the North Thurston Groundwater Management Plan to provide guidance to the county and cities within northern Thurston County. Thurston County's CAO contains language that specifically addresses wellhead protection by designating WHPAs and regulating uses within TOT zones for all WHPAs (Thurston County 1998). Thurston County has also adopted a Nonpoint Source Pollution Ordinance which regulates how waste water, including storm water, is to be handled (Thurston County 1992).

4. SUMMARY AND CONCLUSION

Contaminated aquifers have resulted in the loss of public drinking water supplies throughout the world. In 1986, Congress amended the Safe Drinking Water Act mandating states to develop Wellhead Protection Programs. Tribes, states, and local governments have taken a variety of approaches to protect ground water within their jurisdiction. The predominant approach includes defining Wellhead Protection Areas and identifying prohibited and conditional land uses and activities within these Wellhead Protection Areas.

Wellhead Protection Areas are commonly subdivided into zones based on either a linear distance from a well, or with a radius based on the time of travel for ground water movement to the well. Three protection zones are defined in the literature. Zone 1 can range from 100 feet to 400 feet for the fixed radius method and up to a 1,000-foot buffer around a one-year time of travel zone. Zone 1 has the most stringent restrictions on land uses and activities. Zones 2 and 3 are usually based on time of travel estimates with defined prohibited and conditional uses. Some wellhead protection plans include buffers adjacent to and upslope of Zone 3.

Another method of protecting ground water drinking supplies includes regulating land uses in aquifer recharge zones and preserving critical wetlands. To ensure critical aquifers are protected, a variety of ordinances have been developed by various governments. These ordinances include zoning, health, critical areas, and wellhead protection.

Wellhead protection plans, guidelines, and ordinances have been developed by different governments to protect ground water. In general, these documents promote the active management of land uses and activities, the inventory and management of regulated substances, and public involvement and education. Ordinances have definitions of significant terms, enforcement guidelines, and a severability clause in order to ensure compliance by the community.

Indian nations and tribes take different approaches to protecting ground water within reservation boundaries. The Makah Nation is developing Environmental Regulations, guidelines for understanding National Pollution Discharge Elimination System permitting, and a Solid Waste Disposal Ordinance. The Swinomish Tribe has developed a Wellhead Protection Ordinance that closely follows Washington State guidelines. The Swinomish have adopted the most stringent Zone 1 size to include a 1,000-foot linear buffer around the one-year time of travel to protect against chemical, viral, and microbial contamination. The Tulalip Tribes developed a Watershed Management Plan to study each watershed on the reservation and to protect environmentally sensitive lands from degradation.

States have developed wellhead protection guidelines for local governments within their jurisdiction. New Hampshire developed a health ordinance model that can be coordinated with the reclassification of ground water to either delineated Wellhead Protection Areas or ground water of high value for present or future use. Massachusetts developed guidelines to protect both surface and ground water drinking supplies. Massachusetts has prohibited specific land uses and activities within 100 feet of reservoirs and their tributaries. Massachusetts also mandates a buffer of 400 feet around each wellhead be owned and managed by the well owner.

Oregon has taken an integrated approach to wellhead protection. The Department of Environmental Quality and Oregon Health Department are the lead agencies. Their approach is to integrate wellhead protection with the state Health Division, the Water Resources Department, the Department of Agriculture, and the Department of Land Conservation and Development. Washington integrates wellhead protection with the requirements of the Growth Management Act's Critical Areas Ordinance (which protects aquifer recharge zones) the State Environmental Policy Act (which provides guidelines for land uses and activities) and state Drinking Water Regulations (which mandates local governments and Group A water associations develop Wellhead Protection Plans).

With state guidance, local governments have taken different approaches to protecting ground water. The Dayton, Ohio Wellhead Protection Ordinance uses a geographical information systems overlay to guide its planning department in issuing permits.

Stratham, New Hampshire identifies Aquifer Protection Districts and regulates land uses and activities to reduce the risk of contaminating aquifers. Lancaster County, Pennsylvania developed specific guidelines to protect geologic formations that allow for the rapid infiltration of surface water to ground water. Hernando County, Florida regulates land uses in Special Protection Areas (those areas with rapid infiltration of runoff). Hernando County adopted a Groundwater Protection and Siting Ordinance that designates the entire county as a ground water protection area.

In Washington State, local governments protect ground water through aquifer protection with the Critical Areas Ordinance, zoning ordinances, and wellhead protection ordinances. As an example, Kitsap County has developed a Wellhead Protection Plan with a focus on pollution prevention. Thurston County's CAO includes language to protect wellheads. Thurston County has also developed a Nonpoint Source Pollution Ordinance regulating the management of storm water runoff. The City of Olympia adopted a Wellhead Protection Plan and Ordinance that relies on public involvement and education in an attempt to promote responsible behavior of local businesses and residents.

Wellhead protection planning is essential to protecting ground water drinking supplies for current and future uses. A wellhead protection ordinance allows local governments the authority to better manage land uses and activities that have the potential for contaminating ground water. The literature reviewed indicates that compliance with rules designed to protect ground water can be increased by combining education and enforcement actions.

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